Reliable before-fabrication forecasting of expected surface slope distributions for x-ray optics

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Numerical simulation of the performance of new beamlines and those under upgrade requires sophisticated and reliable information about the expected surface slope and height distributions of planned x-ray optics before they are fabricated. Obtaining such information should be based on the metrology data measured from existing mirrors that are made by the same vendor and technology, but, generally, with different sizes and slope and height rms variations. In this work, we demonstrate a method for highly reliable forecasting of the expected surface slope distributions of the prospective x-ray optics. The method is based on an autoregressive moving average (ARMA) modeling of the slope measurements with a limited number of parameters. With the found parameters of the ARMA model, the surface slope profile of an optic with the newly desired specification could reliably be forecast. We demonstrate the high accuracy of this type of forecasting by comparing the power spectral density distributions of the measured and forecast slope profiles. Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Keywords: surface metrology, surface profilometer, autoregressive moving average, ARMA models, power spectral density, calibration, fabrication tolerances, metrology of x-ray optics

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